

Towards A Dynamic Data-Based Decision-Making Tool

by

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Abstract

Educational leaders must find effective ways to reform the quality of education if the gap between what society desires and what education delivers is to be reduced. Recent reform efforts, where parts of the educational organization are isolated and tinkered with, have lacked sufficient focus for systemic change. With the call for a closer look at schools as complex dynamic systems comes a growing need for the proper tool(s) to assist leaders in this process. Two recent technological developments—the increase in powerful desktop computers and systems dynamics modeling software—have created a realistic potential for the development of such a tool: the simulation of schools-as-systems. Using simulation to better understand the “behavior of schools”, educational leaders can develop and implement more effective policies, saving “real” schools from yet another failed reform, and, increasing the quality of education.

Why Simulation?

Currently, there is not a dynamic tool to help educational leaders identify the systemic areas needed for reform. Rhodes (1994) describes some uses of technology which:

support the organizational interactions that align and connect isolated actions of individuals and work groups as they attempt to separately fulfill the common aims of the organization; and ensure that experiential ‘data’ turns into institutionalized knowledge as the organization ‘learns’. (p. 9)

Prigogine and Stengers (1984) report that “we are trained to think in terms of linear causality, but we need new ‘tools of thought’: one of the greatest benefits of models is precisely to help us discover these tools and learn how to use them” (p. 203).

Schools are dynamic, complex organizations. Senge (1990) points out that counterintuitive behaviors appear in these kinds of organizations. The variables are confusing. For example, Waddington’s (1976) housing project case hypothesized that by simply building housing projects, slums would be cleared out. However, these projects then attract larger numbers of people into the area, and these people, if unemployed, remain poor and the housing projects become overcrowded, thereby creating more problems than before. An awareness of such counterintuitive behavior is a prerequisite if educational leaders are to develop and implement successful reform efforts.

Four major counterintuitive behaviors of systems that cognitively challenge educational leaders have been identified by Gonzalez and Davidsen (1993). These behaviors are: a) origin of dynamic behavior, b) lag times, c) feedback, and d) nonlinearities.

Origin of dynamic behavior.

This is the interaction between systemic variables and the rate of resources moving into and out of those variables. The origin of dynamic behavior itself is confusing to humans in that the accurate identification of all relevant variables and rates can be difficult.

Lag time.

In systems, the element of time can create counterintuitive behaviors through lags between systemic variables and rates of moving resources. An ignorance of lag time by management, ignoring or postponing corrective actions until they are too late, can create oscillatory behaviors in system outputs. Short term gains can actually create long term losses.

Feedback.

The identification of feedback usage can illustrate how actions can reinforce or counteract each other (Senge, 1990). This allows educational leaders the ability to discover interrelationships rather than linear cause-effect chains. This discovery provides the opportunity to focus on reoccurring patterns.

Nonlinearities.

Schools operate in response to the effects of complex interrelationships rather than linear cause and effect chains (Senge, 1990). Sometimes these interrelationships operate at a point where small changes in the system result in a “snowballing” effect that seems out of proportion to the cause (Briggs, 1992). A better grasp of the nonproportional interrelationships in systems is needed for decision-making and policy analysis.

Complexity in Schools

In focusing on the nonlinear system aspects of schools, one must incorporate concepts from the emerging science of complexity, or the study of “the myriad possible ways that the components of a system can interact” (Waldrop, 1992, p. 86). Complexity is a developing discipline that accounts for the newly discovered relationship between order and chaos. Wheatley (1992) describes how these two traditionally opposing forces are linked together.

Those two forces [chaos and order] are now understood as mirror images, one containing the other, a continual process where a system can leap into chaos and unpredictability, yet within that state be held within parameters that are well-ordered and predictable. (p. 11)

Schools are dynamic complex environments that evolve over time. Educational leaders generally measure and even forecast the social and political climates before implementing reform efforts, but they must also understand how unexpected changes in the school system can create the need to adapt policies and procedures if success is to be achieved. O'Toole (1993) argues that the goal of policy is simplification. "Before an executive can usefully simplify, though, she must fully understand the complexities involved" (p. 5). Wheatley (1992) states that "when we give up myopic attention to details and stand far enough away to observe the movement of the total system, we develop a new appreciation for what is required to manage a complex system" (p. 110).

Using the science of complexity—systems thinking—as a theoretical foundation, educational leaders can observe and better understand the interrelationships found in school systems, and therefore, increase their competence in implementing successful reform measures. Only recently has the technology caught up with the theory. Simulation can now combine both the power of systems theory and the emerging science of complexity in a management tool to be used by the practitioner in the field.

Cognition in Simulation

Complex simulations create an opportunity for the participant to master both experiential and reflective cognition (Norman, 1993).

They [simulations] support both experiential and reflective processes: experiential because one can simply sit back and experience the sights, sounds, and motion; reflective because simulators make possible experimentation with and study of actions that would be too expensive in real life. (p. 205)

For over twenty years cognitive processes of subjects have been studied in laboratory settings, where they interact with complex dynamic systems in such a way that "the comprehensive work . . . has provided a rich theory of human cognition and decision-making in complex, dynamic problem situation[s], including social systems" (Gonzalez & Davidsen, 1993, p. 7).

In experiential cognition, the participant's skills are developed and refined to the point of automatic reflexive action during simulation sessions (Schön, 1983; Norman, 1993). The participant's reasoning and decision-making skills are developed and refined to the point where reflective thought is automatic both before and after simulation sessions.

One important element that reinforces cognition during simulation sessions is Erikson's (1963) notion of play, or the attempt to synchronize the bodily and social processes with the self.

When man plays he must intermingle with things and people in a similarly uninvolved and light fashion. He must do something which he has chosen to do without being compelled by urgent interests or impelled by strong passion; he must feel entertained and free of any fear or hope of serious consequences. He is on vacation from social and economic reality—or, as is most commonly emphasized: he does not work. (p. 212)

Experiential cognition is reinforced when participants lose themselves playing with simulations—similar to the child absorbed while playing at an arcade-style video game. The results from these simulation sessions are a heightened experience, or flow (Csikzentmihalyi, 1990).

Playing simulations also provides a collaborative environment for educational leaders—a sharing of new ideas with colleagues who also play the simulation. The players create a standardization of vocabulary of school system simulation terms. Hass and Parkay's (1993) findings support an apparent benefit of such a sharing environment: the increase in interpersonal skills between team members of a group. In simulation sessions of the M-1 tank, the U. S. Army reported that during simulated stressful conditions groups of simulators were as useful for teaching teaming skills as they were for teaching the mechanics of tank operation.

Promises of Simulation in Educational Reform

Computer simulation promises a number of outcomes for educational reform. People who are not scientists will be able to create models that elicit some feeling for the implications of various policy options, without having to know all the details of how that model actually works (Waldrop, 1992). Such models would be management flight simulators for policy, and would allow educational leaders to practice crash-landing school reform measures without taking 250 million people along for the ride. The models wouldn't even have to be too complicated, so long as they gave people a realistic feel for the way situations developed and for how the most important variables interact.

The technology, rationale, and expertise required for creating school simulations are all readily available. It is now up to educational leaders to come forth and demand complex dynamic system simulations as viable data-based decision-making tools for the coming millennium. Any other choice may be determinant in creating less than desirable outcomes.

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